Landsat 7 Processing System (LPS)

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AGENDA

Open Session

- **Purpose**
- **Ground Data System Overview**
- **Requirements Overview**
- **Operations Concept**
- **Organizational Roles and Responsibilities**
- **Software Development**
- **Development Environment Configuration**
- **Schedule**

Closed Session

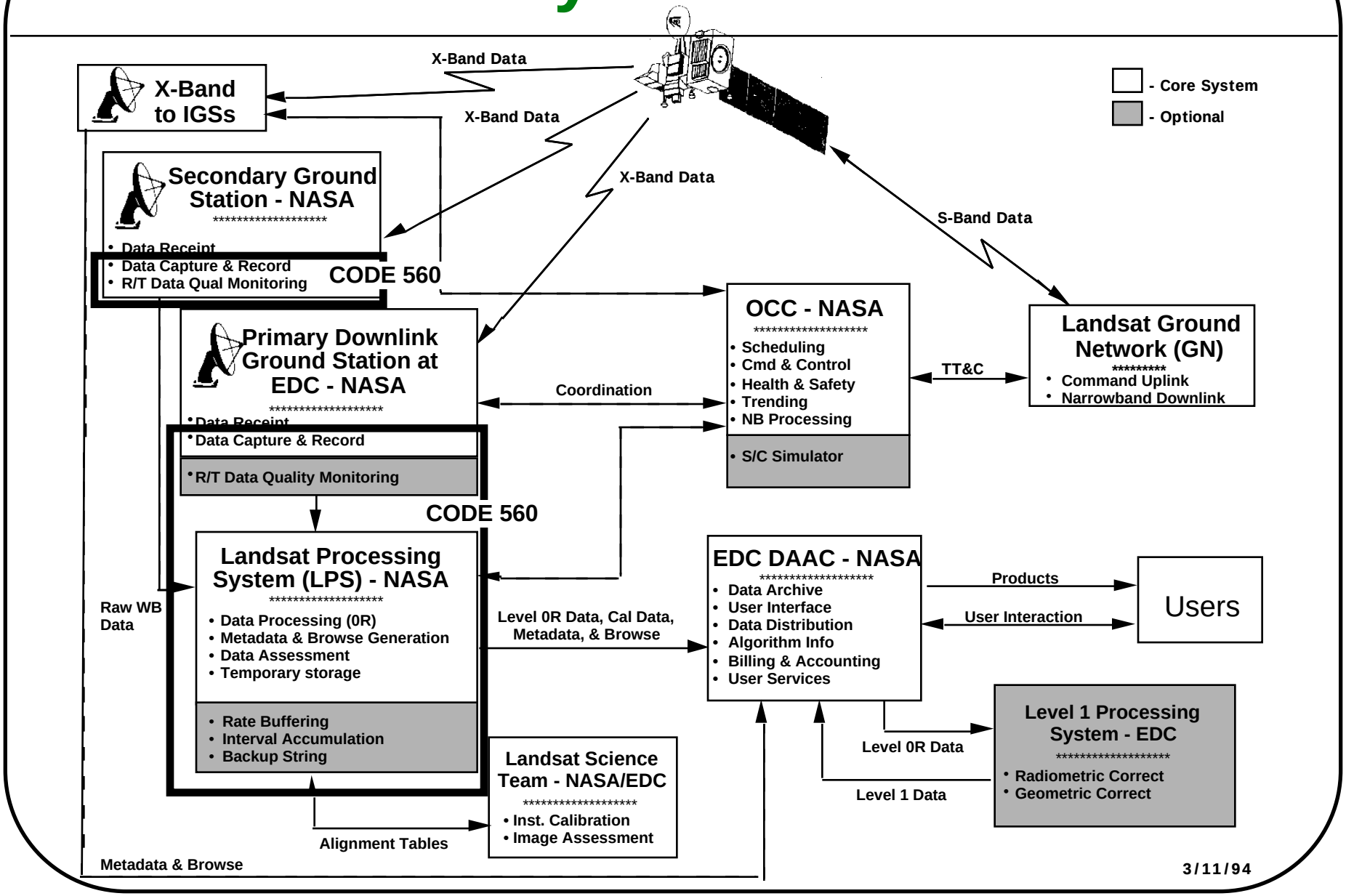
- **Budget**
- **Staffing**

Purpose

To obtain approval for the LPS project plan and approach

- **Identify roles and responsibilities within IPD for LPS development**
- **Present development schedule**
- **Present budget and resource estimates**

Ground System Overview



LGS Allocated Requirements

- The LGS shall generate 4 physical channels of serial data at 75 Mbps per channel.
- The LGS shall record all return link data.
- The LGS shall forward the recorded Landsat 7 data to the LPS.
- The LGS shall have the capability of supporting a return link session duration of up to 14 minutes.
- The LGS shall retain captured wideband data for a minimum of 60 days.
- The LGS shall notify the LPS regarding the transmission of captured wideband data.
- The LGS shall coordinate with the LPS to process all wideband data to Level 0R within 24 hours after receipt from the Landsat 7 spacecraft.
- The LGS equipment shall introduce no more than one bit error in 10**9 bits processed.

LPS Allocated Requirements

- The LPS shall receive rate buffered wideband data from the Landsat 7 Ground Station (LGS).
- The LPS shall be capable of receiving wideband data in CCSDS Advanced Orbiting System (AOS) format.
- The LPS shall provide mission operations for a minimum of 5 years.
- The LPS shall be capable of receiving the equivalent of 250 scenes per day.
- The LPS shall have the capability to handle 12 Mbps daily average aggregate data rate.
- The LPS shall generate the following standard products: Level 0R, metadata and browse files.
- The LPS shall process all wideband data received to Level 0R on a return link session basis.
- The LPS shall process all wideband data to Level 0R within 24 hours.
- The LPS shall provide the capability to reprocess wideband data.

LPS Allocated Requirements (cont.)

- The LPS shall provide CCSDS AOS Grade-3 service on the wideband data.
- The LPS shall have the capability to perform Bose-Chaudhuri-Hocquenghem (BCH) error detection and correction decoding.
- The LPS shall provide return link quality and accounting information for all wideband data as part of the metadata product.
- The LPS shall process all wideband data received per return link session by VCID within each physical channel.
- The LPS shall perform Automatic Cloud Cover Assessment (ACCA).
- The LPS shall be staffed to support integration and test TBD months prior to launch.

LPS Allocated Requirements (cont.)

- The LPS shall coordinate with the LGS to schedule wideband data playback.
- The LPS shall notify the EDC DAAC regarding the availability of Level 0R, metadata, and browse files.
- The LPS shall allow the EDC DAAC to electronically retrieve data files.
- The LPS shall receive confirmation for the successful retrieval of data files from the EDC DAAC.
- The LPS shall have an operational availability for data processing functions of 0.96 or better.
- The LPS shall introduce no more than one bit error in 10**9 bits processed.
- The LPS shall protect all data within the LPS as Sensitivity Level TBD as specified in Applicable Document 3, NASA Automated Information Security Handbook except for sect 403d(2), Information and Applications Labels.
- The LPS shall meet the Criteria of C2, Level 3 controlled access protection.

LPS Performance and RMA Requirements

PERFORMANCE REQUIREMENTS

- Maximum physical channels = 4
- Rate buffered data rate per physical channel = 7.5 Mbps
- Average aggregate science data rate = 12 Mbps
- Provide data products within 24 hours of receipt

RMA REQUIREMENTS

- Processing Availability = 0.96
- Mean Time To Restore = 4 hours
- Single Points of Failure Allowed

EDC DAAC data retrieval within TBD minutes

LPS Products

Level 0R

- Reformatted instrument data corresponding to an interval or subinterval that are unrectified. The product is reformatted which involves fixed and predefined integer pixel shifts. Reformatting for the ETM+ includes: reversing the order of the reverse scan data, aligning the odd and even detectors, aligning the spectral bands, replicating (TBR) the LWIR data, and nominal alignment of the forward and reverse scans. All manipulations are reversible.

Metadata

- Descriptive information pertaining to the Landsat 7 data sets including such information as location and acquisition date.

Browse

- A lower resolution image for the purpose of determining the geographical coverage, information content and image quality.

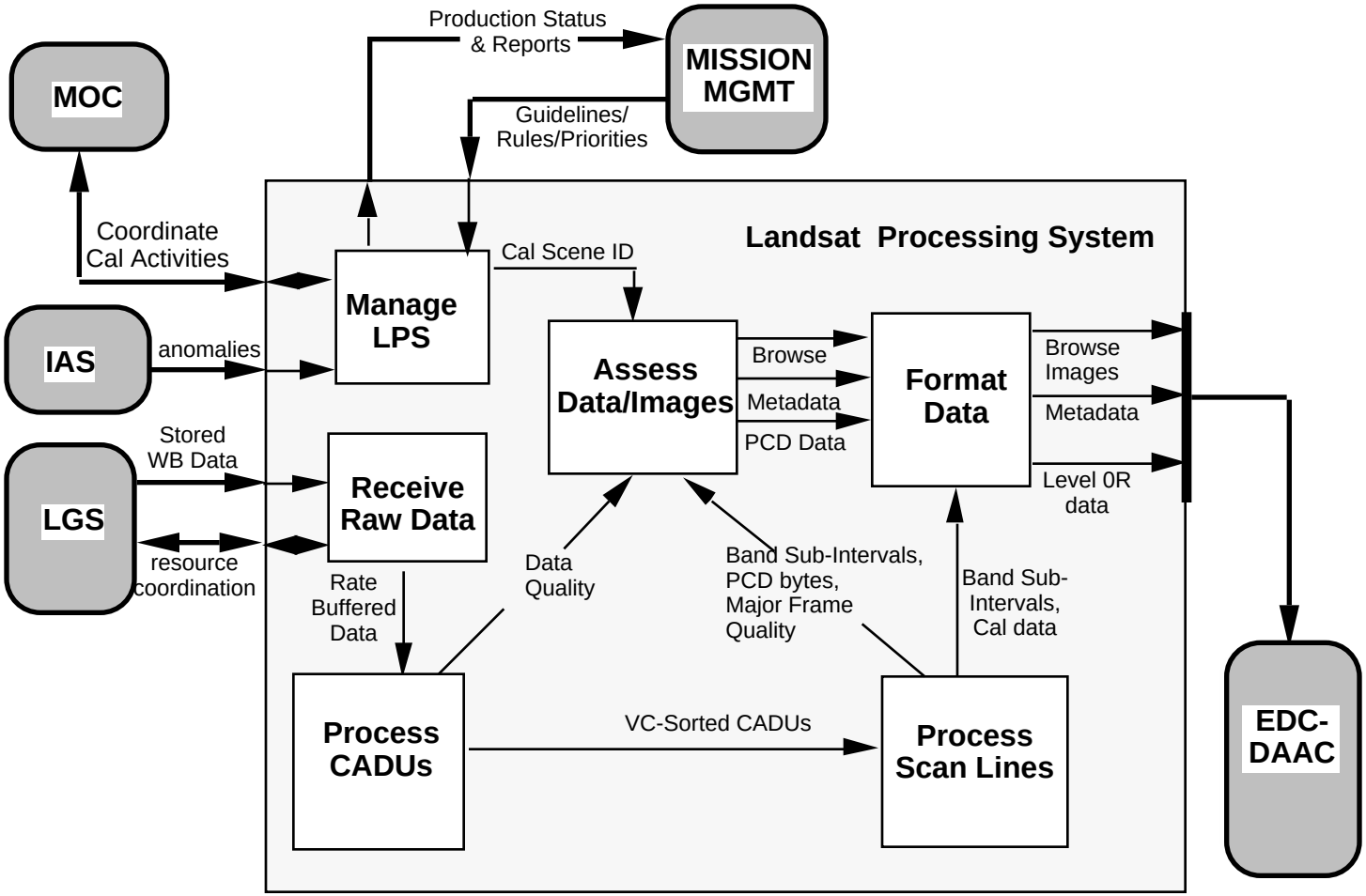
LPS Operations Concept

- Receive raw data replayed from the Landsat Ground Station (LGS) at 7.5 Mbps per physical channel
- Process Channel Access Data Units (CADUs)
  - Perform Frame synchronization and PN Decoding
  - Perform Virtual Channel Data Units (VCDU) Cyclical Redundancy Check (CRC) calculation
  - Perform Reed-Solomon error detection/correction on header
  - Perform BCH error detection/correction on data zone and data pointer
  - Sort CADUs by Virtual Channel ID
  - Collect return link data quality and accounting statistics

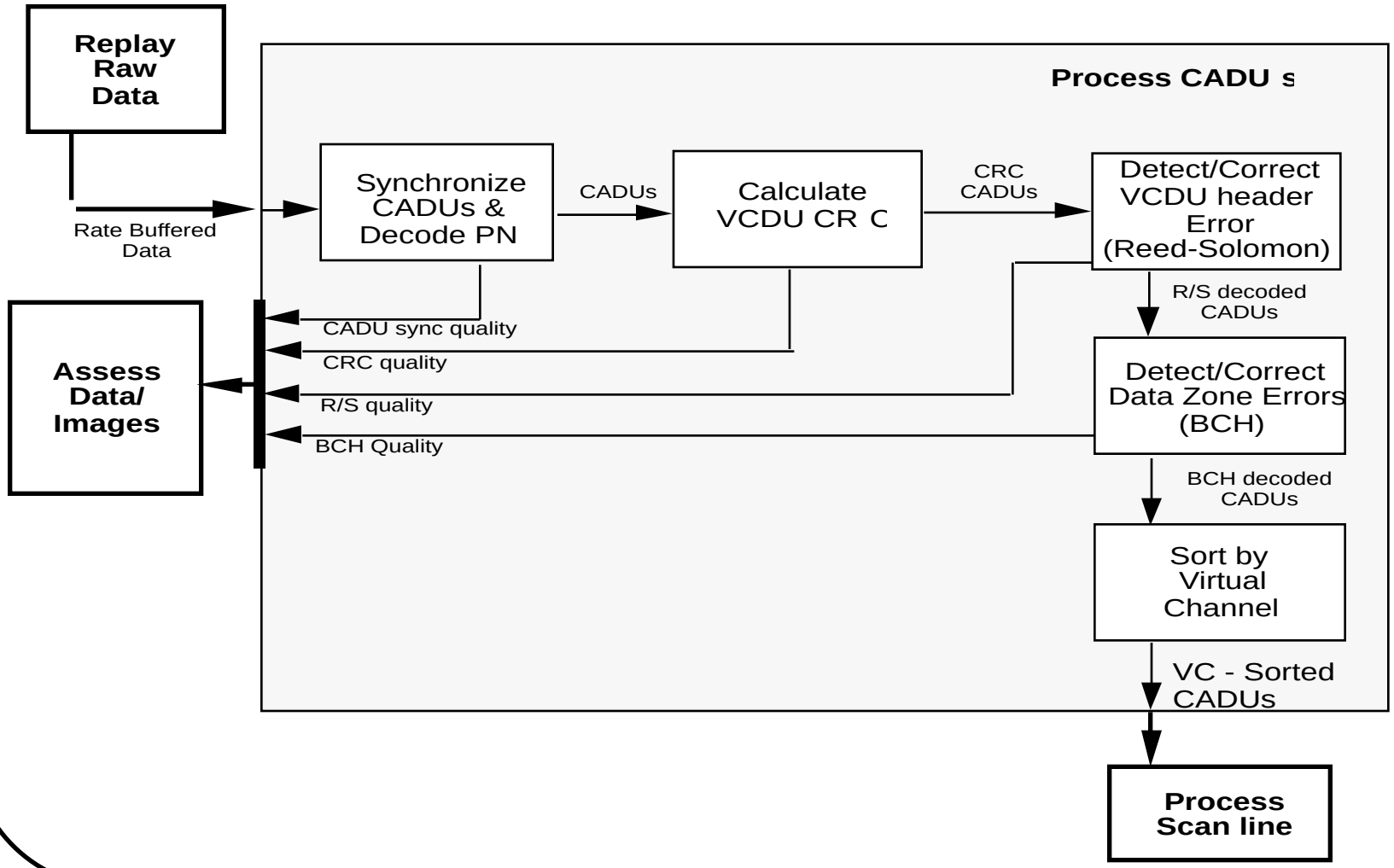
Operations Concept (cont.)

- Process Scan Lines
  - Identify minor frames
  - Extract Payload Correction Data (PCD) from within CADU
  - Perform Major Frame Synchronization
  - Reverse and Deinterleave Spectral Bands
  - Perform alignment of odd and even detectors
  - Perform nominal alignment of the forward and reverse scans
  - Determine sub-intervals
- Assess Data/Images
  - Assemble Payload Correction Data (PCD) major frames
  - Identify Scenes with respect to Worldwide Reference System
  - Generate browse data
  - Perform Automatic Cloud Cover Assessment (ACCA)
  - Generate metadata
- Format data for output to the EDC DAAC

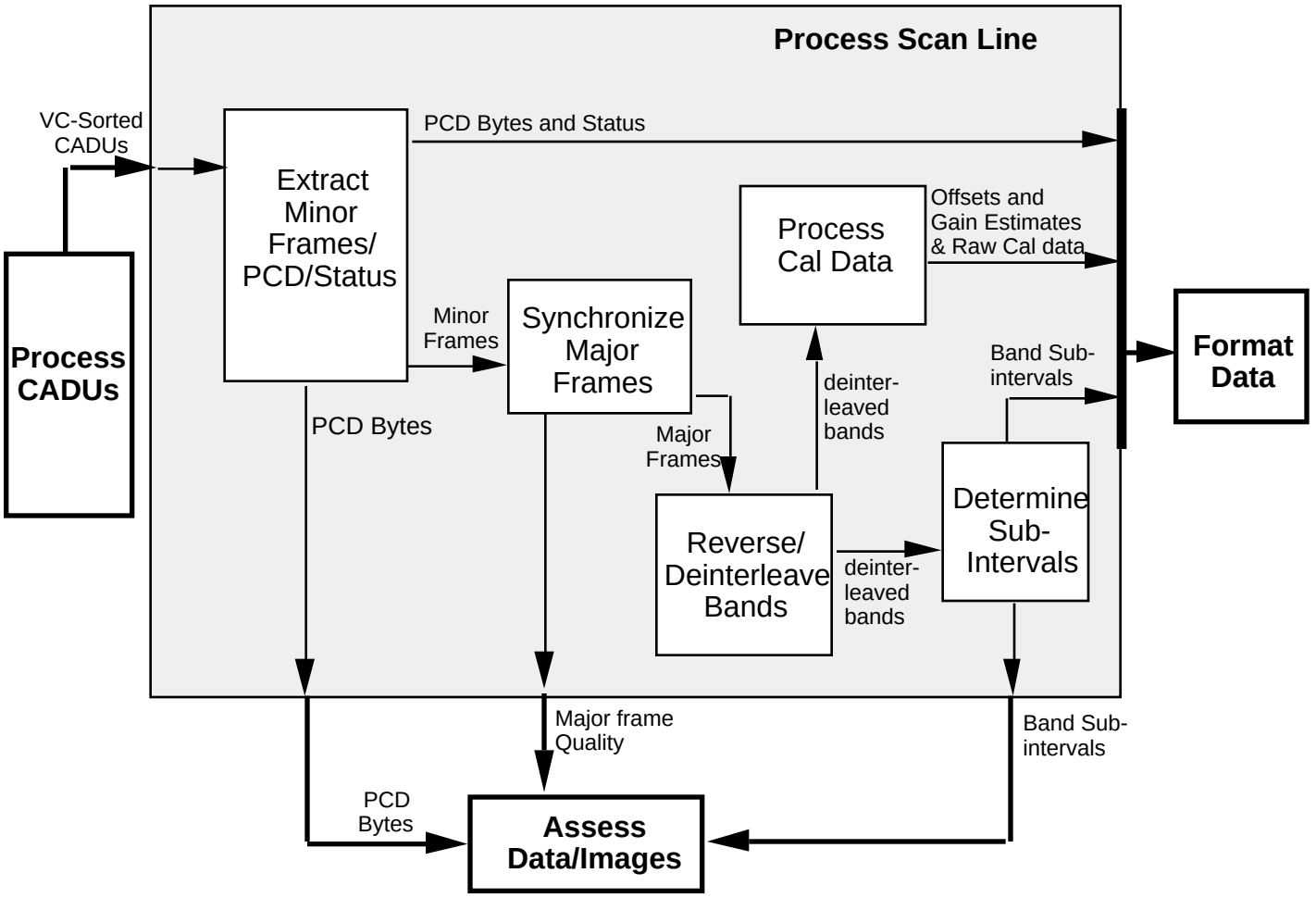
LPS Functional Diagram



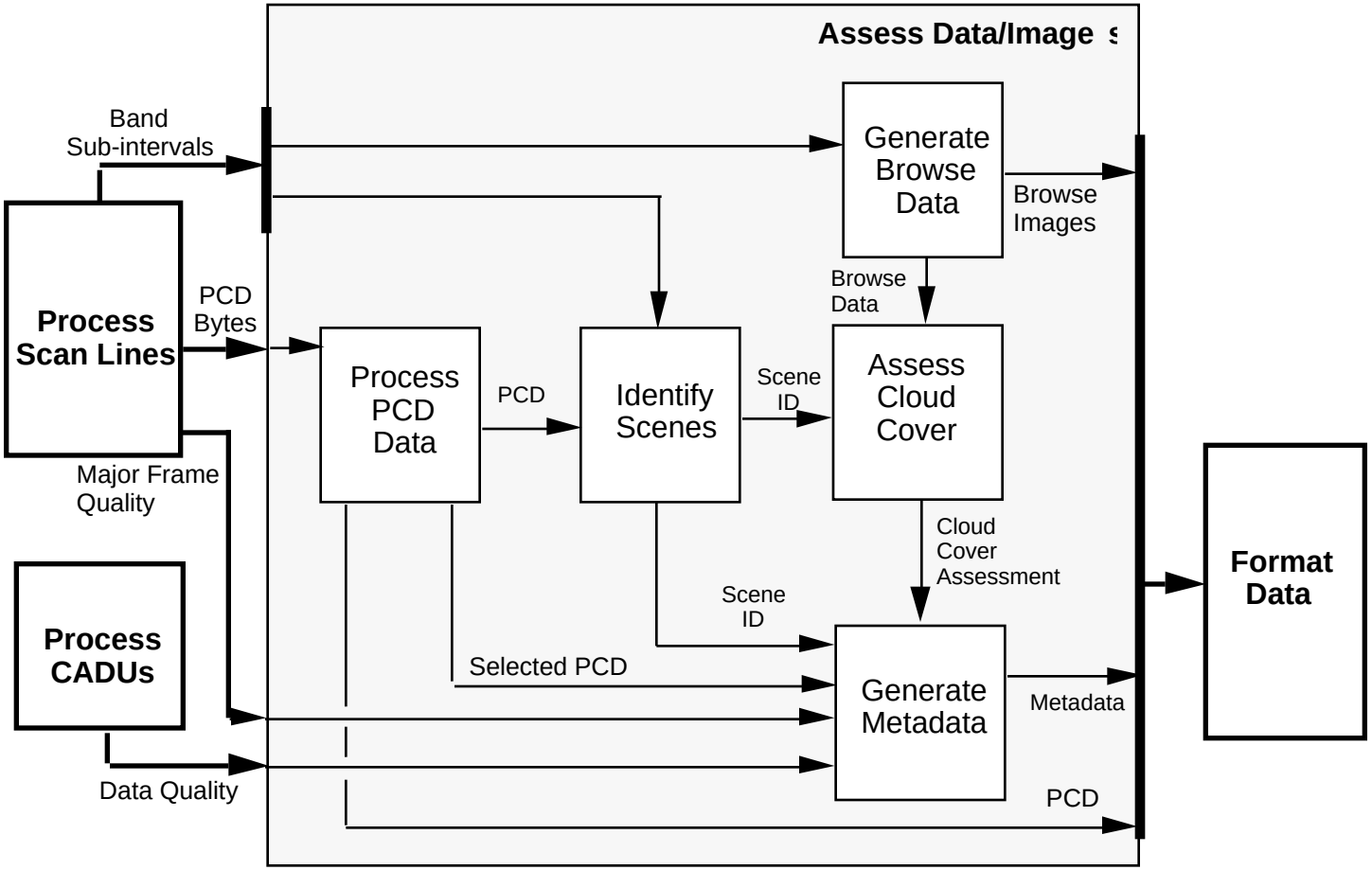
Process CADUs Functional Diagram



Process Scan Line Functional Diagram



Assess Data/Images Functional Diagram



Organizational Roles and Responsibilities

- **LPS Project Manager**
  - Responsible for the implementation of LPS
  - Responsible for controlling budgets, schedules, and performance of LPS
  - Technical management of LPS Project
  - Reports status to upper management
  - Serves as point of contact to Landsat 7 Ground Data System Manager
  - Identifies and obtains resources within Code 560
  - Chairs LPS Project Configuration Management Board (PCMB)
  - Prepares inputs to staff performance appraisals as required
  - Prepares and maintains the LPS PMP
- **LPS System Engineering Manager (SEM)**
- **Engineering responsibilities of the SEM**
  - Responsible to the Project Manager for LPS System Engineering activities and products
  - Heads the LPS system engineering team
  - Serves as Deputy LPS Project Manager as required
  - Serves as ATR for the LPS SEAS System Engineering task
  - Evaluates SEAS task support
  - Maintains system engineering planning documentation

Organizational Roles and Responsibilities (cont.)

- **Engineering responsibilities of the SEM (cont.)**
  - Maintains LPS requirements baselines
  - Establishes risk assessment and determines study and advanced technology priorities and assessments
  - Manages special emphasis studies for risk mitigation
  - Develops and maintains all IRD's, approves all ICD's
  - Functions as focal point for all system-level LPS design activities
  - Member PCMB, serves as alternate PCMB Chair
  - Approves, oversees, and monitors transition activities in coordination with personnel at EDC
  - Other duties as assigned by the LPS PM

- **Integration and Test responsibilities of the SEM**
  - Responsible for all subsystem integration and system test activities and products
  -
  - Oversees and monitors LPS integration and testing activities
  - Approves, oversees, and monitors mission contractor system testing documents
  - Collects and maintains RMA data measurements
  - Interfaces with Landsat 7 Project regarding Independent Verification and Validation test activities

Organizational Roles and Responsibilities (cont.)

- **Operations Responsibilities of the SEM**
  - Approves and maintains the Operations Concept
  - Develop, approve and maintain the LPS Transition Plan and schedules in coordination with personnel at EDC

- **LPS Hardware Manager (HM)**
  - Responsible for all LPS hardware activities and products
  - Responsible for procurement of all system hardware
  - Approves, oversees, and monitors hardware development and test activities
  - Establishes hardware policies, standards, and plans
  - Reviews and evaluates hardware-related products
  - Defines applicable hardware-related prototyping efforts
  - Member PCMB regarding hardware-related changes to controlled baselines
  - Develops and maintains hardware interface requirements
  - Evaluates applicability of new hardware technologies to LPS

Organizational Roles and Responsibilities (cont.)

- **LPS Software Manager (SM)**
  - Responsible for all LPS software activities and products
  - Responsible for controlling budgets and schedules for all LPS software developments
  - Responsible for the procurement of all software development tools in conjunction with SEM
  - Serves as ATR for SEAS software development task
  - Evaluates SEAS task support
  - Responsible for technical management of LPS in-house software development efforts
  - Manage software team activities
  - Manage software integration and test efforts in conjunction with LPS SEM
  - Oversees and monitors software development and test
  - Provides technical leadership in software development methodology
  - Establishes software policies, standards, and plans
  - Identifies applicable software reuse from external sources (such as EDC)
  - Conducts walk-through and audits for conformance to software management plans
  - Lead efforts to identify, select and procure COTS software packages
  - Develops and maintains software interface requirements
  - Develops long-term software management and maintenance philosophy
  - Defines applicable software-related prototyping efforts
  - Member of PCMB

Organizational Roles and Responsibilities (cont.)

- **Software Engineer**
  - Responsible to Software Manager (SM) for LPS software functions as assigned
  - Technical lead of LPS software functions as assigned by SM
  - Insures consistency and software reuse of the design and implementation within the LPS
  - Member PCMB regarding software related changes to controlled baselines
  - Provides inputs to LPS SM for evaluation of SEAS contractor on appropriate software functions as required
  - Other duties as assigned by SM

- **In-house Software Development Manager**
  - Heads in-house software development team
  - Member PCMB regarding software related changes to controlled baselines
  - Other duties as assigned by Software Manager

- **Quality Assurance distributed among PM,SEM,SM,HM**
  - Develops and maintains QA planning
  - Implements and manages the quality assurance program
  - Monitors and ensures conformance to standards
  - Performs audits as required
  - Defines and tracks management indicators
  - Defines, collects, and assesses quality and productivity data

Software Development Methodology

- **Classic Waterfall - Tailored SSDM :**
  - **System Requirements Review**
  - **System Design Phase**
  - **S/W Requirements Specification Review**
  - **Preliminary Design Phase**
  - **Critical Design Review**
  - **Build Design Review(s)**
  - **Unit Testing**
  - **Integration Testing**
  - **System Testing**
  - **Factory Inspection Testing**
  - **Maintenance**
- **Documentation - utilize on-line documentation, minimize tech pubs costs and turn around times**

Software Quality Assurance

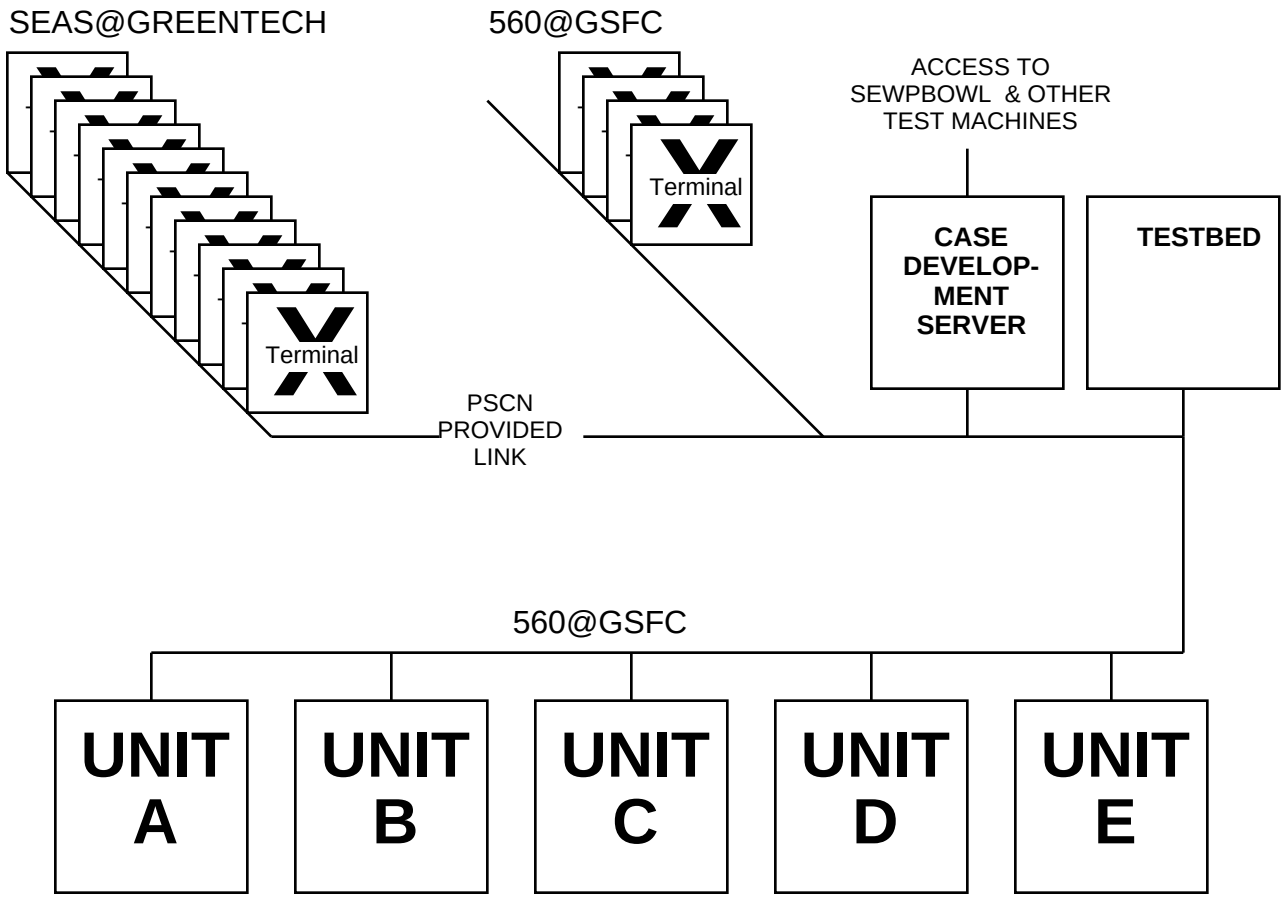
- PDL Walkthroughs
- Defect Causal Analysis Sessions
- Code Inspections
  - Commenting
  - Structure
  - Complexity
  - Modularity
  - Conformance to standards
- CASE Tools
- Standards: ANSI C, POSIX

Studies

Prototyping efforts currently underway

- **BCH Error Detection and Correction - determine the fastest most efficient algorithm and measure performance on various hardware architectures**
- **Band Deinterleaving (completed) - measure byte manipulation performance on various hardware architectures**
- **Major Frame Processing - measure complexity/feasibility of performing scan line processing with minimal data movement**
- **Browse Generation Algorithms - investigating performance of potential algorithms to generate browse images (Wavelets)**

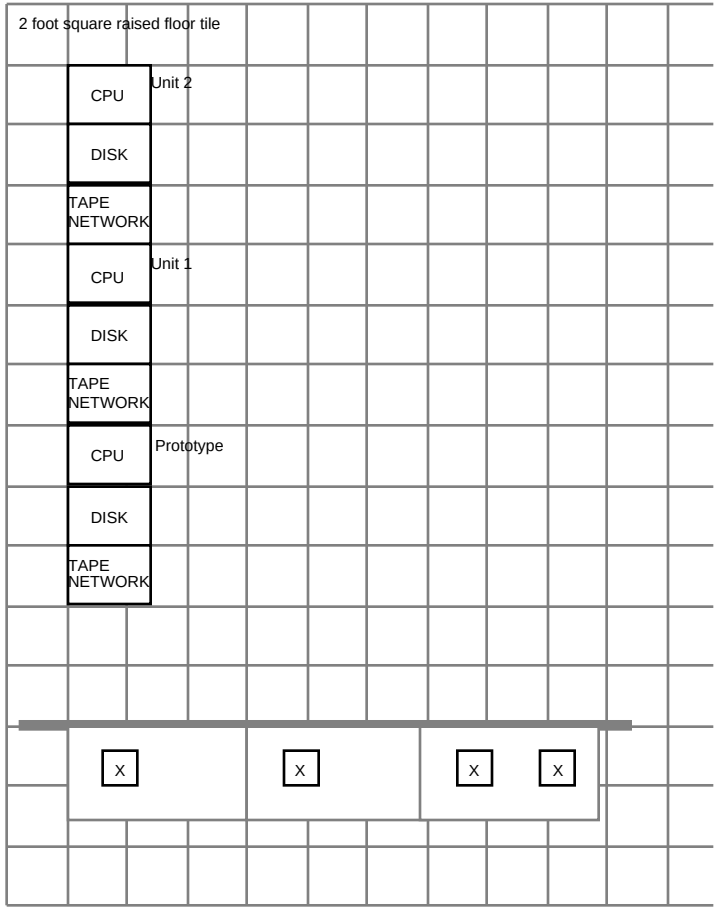
Development Hardware Configuration



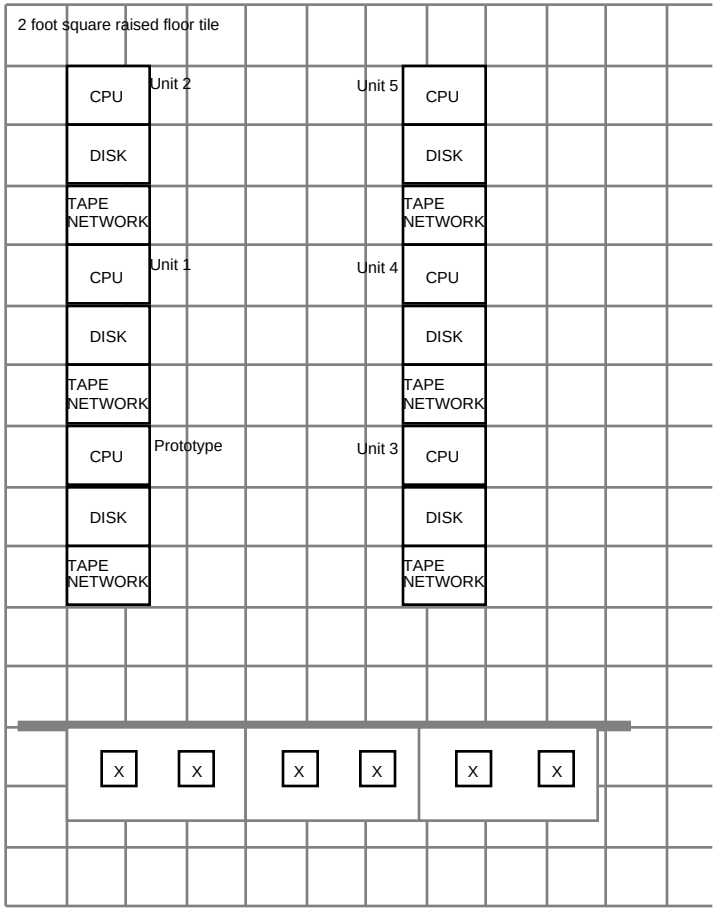
Each UNIT consists of the hardware required to process one wideband telemetry stream.

Floor Layout - Building 23

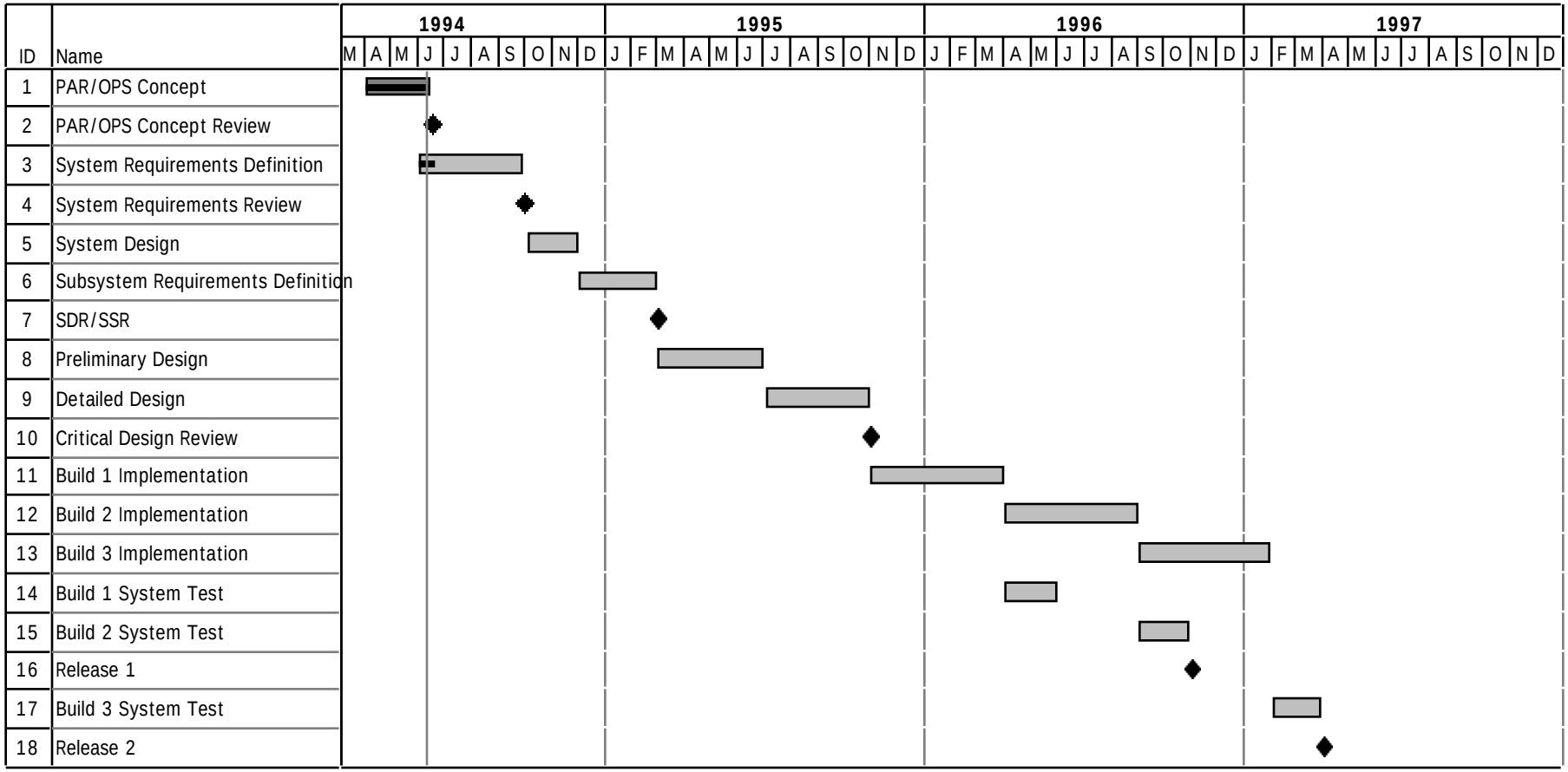
Phase 1



Phase 2



LPS Schedule



December 1998 Launch

Closed

Session